DOOSAN Document Transmittal

Upper Trishuli-1 HEP (216MW)

Date	DT No.:	SHEET
2022-02-28	UT1-HEP-DHI-PC-D-0003	1 OF 1

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1	RN-0066	FI	UT1-C-000-CVL-DD-40012	0A	Supplementary DOP Summary Report	5 SHEET
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Legend of Review Status
A : APPROVED
AN : APPROVED AS NOTED
RR : RETURN FOR RESUBMISSION
FI : FOR INFORMATION

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Doosan Heavy Industries & Construction Co. Ltd. DOOSAN Branch Office Nepal

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for

Youngsoo Son

Project Manager

Email: youngsoo.son@doosan.com
Doosan Heavy Industries & Construction Co., Ltd.

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UPPER TRISHULI-1 HEP (216MW)			
Client	**Nepal Water and Energy Development Company Private Limited**		
Owner's Engineer	**Tractebel Engineering GmbH / Jade Consult**		
REVIEW NOTE			
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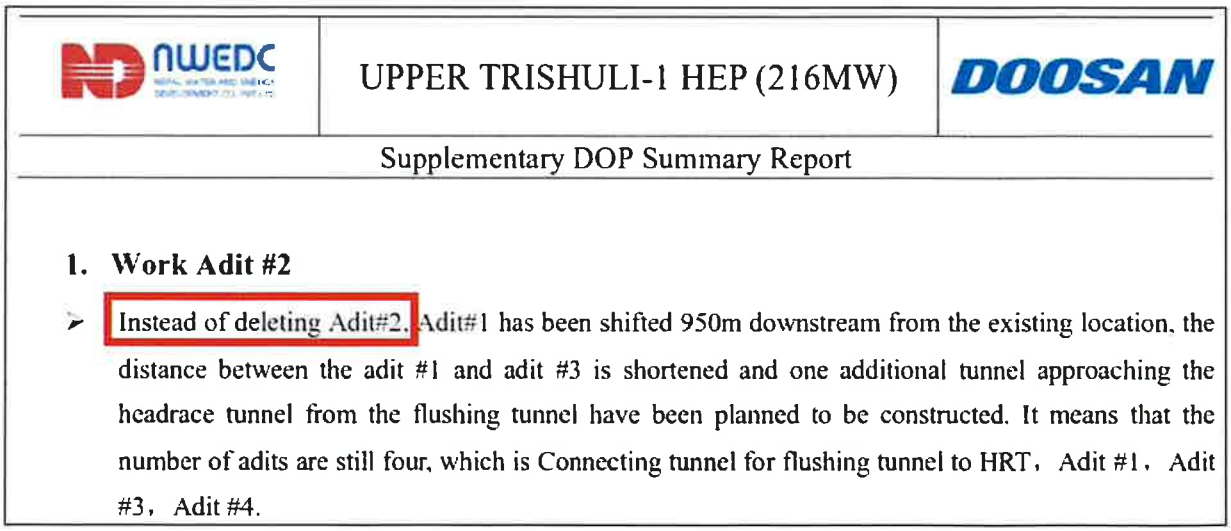
General Comments

This review note RN-0066 only comments the document ref.: *UT1-C-000-CVL-DD-40012_0A* in technical/ design aspects.

As the document under review is part of the Design Optimization Proposal process, it is considered for information only.

1. Work Adit#2:

First paragraph: Contractor´s proposal regarding work adit#2 needs to be clarified, see screenshot below.



NWEDC | UPPER TRISHULI-1 HEP (216MW) | DOOSAN

Supplementary DOP Summary Report

1. Work Adit #2

- Instead of deleting Adit#2, Adit#1 has been shifted 950m downstream from the existing location, the distance between the adit #1 and adit #3 is shortened and one additional tunnel approaching the headrace tunnel from the flushing tunnel have been planned to be constructed. It means that the number of adits are still four, which is Connecting tunnel for flushing tunnel to HRT, Adit #1, Adit #3, Adit #4.

2. Type of cofferdam including ANNEX-I:

- Foundation conditions at cofferdam areas:
  The foundation of the cofferdam consists of boulders, cobbles, gravels, with medium to strong permeability. The thickness of the riverbed overburden layer is about 13m~46m, and the particle size of the boulders is generally 40cm~80cm.

- Cofferdam type:
  (i) From the point of view of functioning, the cofferdams will be constructed as the so-called dry-season cofferdams, which will retain water between November and April (6 months) and be overtopped from May to October (also 6 months) with intensive overtopping of two months (July & August).
  (ii) From the material point of view, the proposed cofferdams are earth (or rock) fill dams.

- Proposed cofferdam:
  The cofferdam has two parts. (i) The main part is from El.1241.28 m to El.1250.0m. It is not a CFRD, but an earth/rock fill dam with surface protection. The upstream slope surface below El.1247.0m will be protected with riprap. From El.1247.0 m to El.1253.0 m and the downstream slope will be protected with reinforced concrete. To resist seepage, jet grouting will be performed down to El.1227.0 m. The valley is narrow and the cofferdam length = 32 m.
  (ii) On the crest of main part of U/S cofferdam, a "sub-cofferdam" of 3.0 m height will be built with sand-gravel material and clay core, extending the cofferdam to El. 1253.0 m. This part will be washed away during each wet season when overtopping. Then, it must be re-build at beginning of each dry season.

- Comments:
  The proposed U/S cofferdam (earth/ rockfill with surface protection) should be working in a general sense. The similar dams (as a low water retaining dam) can be found in literature, and successfully working. However, the working conditions are very different from such water retaining dams from the cofferdams as proposed. In the said water retaining dams, the protection is resisting overtopping water as a spillway, (a) the utilizing time is short (several days to one or two weeks annually), (b) the flow velocity in front of dam lower part is small. In our case, the cofferdam will be inundated in the water for at least of 2 months every year, through which the cofferdam body may become soft, causing large deformation and damage to the protection concrete layer. Moreover, the flow velocity must be rather high due to higher flood and narrow valley and therefore it is questionable whether the protection with eventually cracking can be held.
  In the document, the option of hardfill (same as CSG – Cemented Sand and Gravel) dam was also considered and a comparison with the present cofferdam was conducted, see scheme in subchapter 7.8. of ANNEX-I. However, the special operation conditions described above are not considered. If such operational conditions are considered, the hardfill dam option should be strongly suggested, which is safer.

  For the hardfill dams, the seepage resistant measure for the foundation, such as the grouting, is also necessary.

  If the hardfill dam will be constructed for the u/s cofferdam, then the same should be used for the d/s cofferdam.

ANNEX-I, preliminary results of hardfill cofferdam design

- Special foundation treatment as consolidation grouting and the bottom slab indicated as "rich mix CSGR (cemented sand, gravel and rock)" might not be necessary for the 14-m high hardfill dam
- Leveling of riverbed may be foreseen (bolder blasting, lean concrete)

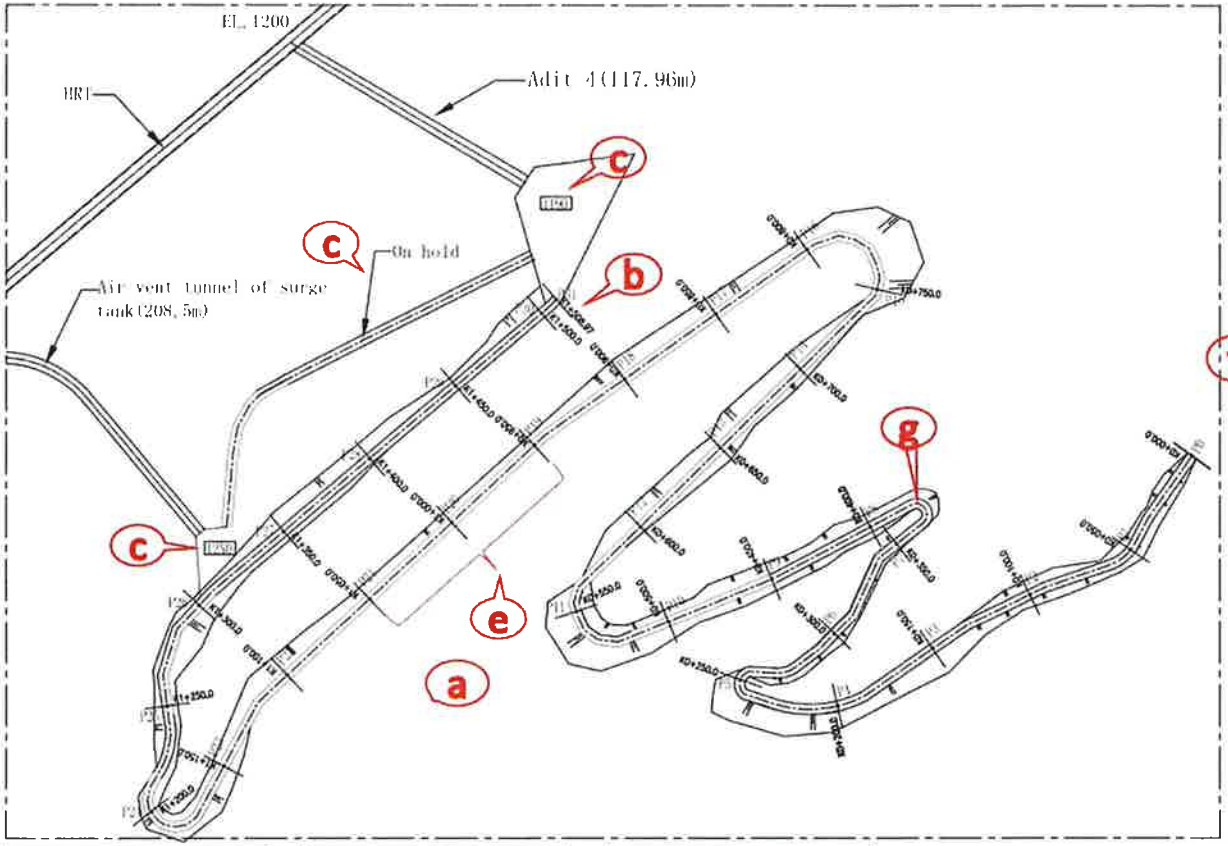
- The D/S slab can be executed with C6 CSGR
- The U/S plinth is reasonable, the plinth D/S of the whole cofferdam structure can be executed also with C6 CSRG
- The grout curtain should be foreseen as seepage resistant measure
- Abutment excavation at cofferdam shoulders to bedrock is not necessary, the grout curtain has to be foreseen as seepage resistant measure at this location as well
- The 0,8m vibrated grout-enriched CSGR at the U/S face may not be work due to the lean hardfill material. Instead a 0,5-1,0 m thick conventional concrete surface at the U/S face, the crown and the D/S face of the hardfill cofferdam should be foreseen
- To facilitate the construction process, the D/S face can be constructed in steps (like stepped spillway)
- Usually for such a low hardfill dam, the nominal compressive strength of 3 to 5 MPa is considered sufficient. The corresponding content of cementitious material (cement or cement plus fly ash) ranges from 60 to 90 kg/m³. As the content of cementitious materials is very low, special temperature control is not necessary
- The indicated guide wall ("C24 concrete facing") is not understood and may be replaced by simplified scour/ erosion protection
- Instead of two stages scheme for the river diversion, the diversion should be conducted in one-go, for which a low pre-cofferdam (starter) should be constructed. Under protection of the pre-cofferdam, the hardfill dam can be constructed
- With respect to the comments above, a construction period of maximum 5 months shall be realistic for the hardfill cofferdam. In this regard, the hardfill cofferdam can be constructed during one dry season, and thus the two-stage diversion construction scheme for the hardfill cofferdam including additional longitudinal pre-cofferdam and bottom outlet can be omitted. The difficulty of connection of 1st and 2nd stage cofferdam is not given anymore.

Access road to proposed Work Adit#4, ANNEX-II:

(see also red indications in drawings below)

a) Contour Lines in layout drawing are missing
b) Total length of 1.508,97m in layout drawing and longitudinal-/ cross section is in contradiction with total length of 1.562,69m in note 1 of layout drawing
c) The connecting road between portal of work adit#4 and portal of air ventilation tunnel of surge tank is indicated as "on hold" which is not acceptable as matter of urgency. While the difference of elevation between both portal areas is 60m, the connecting road would need a horizontal length of 400m, assuming a gradient of 15%.
d) Road superstructure needs to be defined, especially regarding steep gradient of road
e) Inconsistencies between layout and longitudinal section (indication of cut and fill) e.g between P19/P20/P21
f) Note 4: "Before construction must survey out according the route shown in the drawing…". This sentence is not clear. However, detailed survey has to be carried out (topographic and geological) before design, not only before beginning of the construction works.
g) Turning area has to be indicated in layout drawing
h) At least temporary closure of the access road to the aggregate crushing plant and Work Adit#3 has to be considered during construction activity of the above proposed access road. This may have impact to other work fronts.
i) Environmental impacts have to be considered.

Layout of new access road to Adit 4



Note:

1. The total length of the road is 1502.69m, the average slope is 14.30%, the starting point elevation is EL.980m, the elevation of the Adit 4 portal is EL.1190, and the elevation of the surge tank air vent tunnel portal is EL1250. The width of the road is 4.5m. This drawing is only the draft direction of the road. The site can be adjusted according to the actual situation during construction.

2. The roadbed protection below Section 1 is carried out by gabion wall. The excavation slope ratio of the rock slope in Section 2 is 1:0.3 to 1:0.5, Section 3 with rock excavation. The actual excavation method can be adjusted according to actual situation during construction.

3. The road to the air vent tunnel in this drawing is only a draft schematic, and it will be determined after the temporary road is completed .

4. Before construction must survey out according to the route shown in the drawing, and then use a large excavator to excavate the road and connect with the part of road which have finished before. During the construction of the rough road, the direction of the line and the ascending slope must be adjusted continuously. After reaching the end point, the slope protection shall be carried out by sections according the drawings. The crash piers, drainage ditch and road surface shall be constructed at last.

5. The final width of the road surface is 4.5 meters, the width of the roadbed is determined according to different support types. During construction, the passing zones will carried out in different locations according site condition.

6. For some sections of the road that pass through water and gullies, set up necessary drainage facilities.

7. The turning section is a horizontal section greater than 35 meters, and the road surface is rolled and leveled with C20 concrete.

A3, Not in scale

Upper Trisuli 1 HEP
NEW ACCESS ROAD TO ADIT 4 LAYOUT PLAN

DISCLAIMER

Any approval will not release the Contractor from any of his obligations under the Contract.

Sebastian Beck, Chief Design Engineer